

Exactly the same thing happened with the micro as with the macro world: people didn't believe it until they saw it with their own eyes. It wasn't until we made the first telescope that we could see the stars. It wasn't until we made the first microscope that we could see the cellular structure. Now people don't believe in quantum physics even though there are particle accelerators. The problem is that we descend to an even lower level than microscopic where we cannot see things and events, even with the help of special lenses, but we can only detect and calculate them. Honestly, we've actually never even seen half of the space phenomena because telescopes can't detect them in the visible electromagnetic spectrum.

One ad hoc interesting thing about microscopes: the strongest are transmission electron microscopes (TEMs). They can enlarge an object 50 million times. But since they can not be observed in 3D technique, they are only good when the samples are very thin. The optimal choice is a scanning electron microscope (SEM) that magnifies "only" a few million times but uses a 3d technique of scanning by layers, so the final image is significantly more detailed.

What is the nature of the reality? What does matter consist of? The standard model of particle physics says that hadrons (protons, neutrons, mesons) are made up of 6 types of quarks and are connected by gluon – a particle that serves as a mediator of a powerful interactive force.

To start explaining the quantum physics we need to know the basics of particle physics and nuclear physics. The elementary division is into fermions

(quarks: up, down, enchanted, strange, top, bottom; leptons: electron, muon, tau and 3 neutrino combinations of the same) or building matter and bosons (gluon, photon, Z and $2 \times W$ boson) or force mediators. Gluon holds quarks together (strong force), photon is the mediator of the electromagnetic force, Z and $2 \times W$ are the moderators of the weak interactive force. In addition to the 5 previously mentioned gauge or vector bosons, there is a known scalar boson called Higgs which is responsible for the allocation of the mass to the particles reacting with its field.

Nuclear reactions can be fissions (breaking) or fusions (joining) atoms. In fission, the neutron hits the nucleus, usually Uranium or Plutonium, and breaks it down into constituent parts, releasing enormous energy. In fusion, two atoms collide and create a new one – heavier. For example, two hydrogen atoms produce the helium atom. The fusion process keeps the star active and thus defies gravity. It generates much more energy than fission but requires enormous pressure and a temperature of 15,000,000 degrees Celsius which is possible only in star cores or during supernova explosions (for elements heavier than Iron, Fe). In a nuclear bomb, the pressure is offset by a limited space, which is significantly smaller than the sun's core, and a far higher temperature than in the sun's core, as much as 100-300 million Celsius. Once nuclear fuel is depleted, the star collapses into itself under the influence of gravity and, if the singularity theory is correct, ignores the Pauli exclusivity principle by ultimate compression.

There is a phenomenon called quantum tunneling that plays an essential role in nuclear fusion and alpha radioactive decay. When a particle reaches an obstacle it disappears and appears on the other side of the obstacle. It was as if she had plunged into a quantum field and bypassed the obstacle by traveling below or outside spacetime. Given that the temperature at the center of the star is too small to overcome the Coulomb barrier, the situation can only be explained by the QT phenomenon.

The bigger the sun faster it consumes its fuel and sooner it will burn away.
Are supermassive black holes the remnants of the giant ancient suns?

The Higgs boson, theoretically predicted in 1964., was discovered in 2012.
using the LHC, and its existence explains how particles gain mass and why
the Z and W boson are so massive relative to mass-free gluons and photons.

A significant difference between Higgs and other bosons is that Higgs has no
spin while the other 4 have.

The Higgs field is a universal energy field that uses its scalar boson to
allocate mass to particles which is called the Higgs effect.

We know of three statistics: Fermi-Dirac, Bose-Einstein and Maxwell-Boltzmann. The first applies to particles with integer-and-half spin that respect the Pauli exclusivity principle which means that identical particles cannot have the same energy state, and the latter two are valid for particles

with integer spin and do not respect PPE, which means that they can occupy the same energy states or the position in the quantum field.

Spin is an intrinsic property of the tiny particles representing the quantum mechanical form of angular momentum or rotation.

Higgs field, quantum field. I have already mentioned the word "field" several times in this text. Field theory states that there are energy fields that interact with matter through Maxwell's (electromagnetism) and Einstein's field equations or, for short, EFE (geometry of the spacetime).

Is there a quantum field? Judging by what we know (entanglement or "spooky action at the distance" and superposition) it seems to exist. I believe that it is precisely this field that is responsible for the temporal phenomenon or manifestation of the time dimension.

The term quantum (quantum – lat. "how much") is derived from the word quant(a) with which Max Planck described the smallest possible amount of energy and is considered the founder of quantum theory. The quantum of electromagnetic force is a photon and besides waves, it also possesses particle properties, as well as an electron. Already this duality is interesting in itself and is proven by the experiment with 2 openings.

Quantum mechanics is a field of physics that deals with fundamental (subatomic) physical quantities and phenomena or the characteristics and behavior of the tiniest cosmic components, and reveals to us that energy is emitted, transmitted or absorbed in quantum or quanta.

Quantum mechanics is already used in microwave ovens, fluorescent bulbs, semiconductors, lasers, MRI (magnetic resonance imaging) and in atomic clocks.

Moreover, it is noticeable in many life phenomena although we have never paid attention to it laconically attributing all phenomena to the laws of macro-physics. Here is one example: a small worker's salary in parallel is and is not – "it is" because it has a certain amount and "it is not" because it has already been spent in advance (reserved).

Planck derived his constant, h , by studying the blackbody radiation that, at room temperature, emits in the infrared spectrum. By increasing the temperature, the spectrum passes into visible, purple and finally into ultra-violet. Before Planck, the black body was dealt with by Kirchhoff.

By combining the formulas $E = m c^2$ and $E = h \nu$ we realize that everything has its own frequency even mass or particles. Matter oscillates, wobbles on the energy fields like on a spider web.

Max Planck determined the infinitesimal quantities of time (10^{-43}), space (10^{-35}) and mass (10^{-8} kg) at which laws of quantum physics start to apply.

Quantum glossary:

After Niels Bohr (Copenhagen interpretation), who devised the principle of correspondence between classical and quantum physics, it is named the Bohr model of an atom in which electrons can move only by those circular trajectories where the angle of motion is determined by $h/2\pi$ and the Hydrogen atom (H) emits a photon, or the quantum of the EM radiation when an electron passes from a higher to a lower energy level.

$$E = h \nu \quad E = -h \nu / 2\pi \text{ (electron)} \quad E = h f = h c / \lambda$$

ν (or f) - the frequency of electromagnetic radiation

h - Planck constant

λ - the wavelength of light

Werner Heisenberg is credited with the so-called Heisenberg's uncertainty principle which states that it is not possible to simultaneously measure the position and speed of a particle at the same time both with the maximum precision.

Schrödinger's equation (named after Erwin Schrödinger): quantum objects are derived using probability wave functions that describe the movement of the particles and external influences on their movement.

Entanglement: two objects connected or paired into a single system, e.g. two photons or two electrons, although they retain common characteristics very far apart from each other. Lasers and a special crystal are used to divide one particle into two that remain in perfect correlation, disrupting the principles of locality and causality. Einstein, Podolsky and Rosen proposed the possibility of hidden variables, but later works by Bell and Clauser eliminated this possibility.

Superposition: An object can be in a multiple states simultaneously and may show different measurement outcomes for each of these special states.

Micius (Mozi), China's quantum-protected communications satellite QUESS and Baidu Qian-shi 10 or 36 qubit machines, shows that pairing works in thousands of kilometers away photons. Freedman-Clauser was the first experiment of its kind testing Clauser-Horne-Shimony-Holt (CHSH) inequality.

Peter Shor's algorithm theoretically exposes how future quantum computers could crack RSA encryption, which is currently used to encrypt websites using private and public keys, by accelerating defactorization. Quantum key distribution (QKD) uses photon sequences to detect, by measuring on both sides, whether the shipment has been compromised. The "Sagnac effect" interferometer is a device for creating paired photons.

Decoherence: an electron acts like a wave until we look at it and when we look at it a wave collapses and acts like a particle.

Quantum computer: compared to a conventional circuit that uses bit(s), stored on transistors, the quantum computer uses qubit(s), stored on a superconductor or in a more advanced version, a special crystal in which lasers trap ions. Qubit is a bit in superposition, both 0 and 1 at the same time. Given the power of such devices in the foreseeable future it will be possible to decipher even the strongest available encryptions: RSA 2048 to 4096 bit. How does a quantum computer work? There are already analogues, up to 100 qubits, and in the future it is planned to build universal with over 100,000 qubits.

Quantum annealing: D-wave announces a 2,000 qubit computer that will work on the principle of quantum annealing using quantum fluctuations and promptly adapting its own algorithm to newly emerging circumstances.

Time crystal: a new state of matter, in addition to the existing solid, liquid, gaseous, plasma (gaseous state rich in charged particles or ions and fuzzy electrons, example: aurora, lightning, neon advertisements, welding tools, plasma ball) and Bose-Einstein condensate (supercooled diluted gas e.g. rubidium atoms in which a large number of particles are in the same energy state) - the crystal that periodically changes its configuration without energy modification. The Google Sycamore 53-qubit quantum computer is experimenting with time crystals.

Quantum vortex: a vortex formed in superliquids or in super conductors.

In addition to the already mentioned earlier in the text, there are several other important names in the field of quantum physics: Henri Poincare (polymath, determinism of the chaotic system), Hendrik Lorentz (L. transformations, L. force) and Pieter Zeeman (Zeeman effect), Max Born (wave function statistics), Paul Dirac (pozitron) and Richard Feynman (quantum electrodynamics, diagrams).